

## REMARKS

The Applicants appreciate the Examiner's thorough examination of the subject application. Applicants request reconsideration of the subject application based on the following remarks.

Claims 1-3, 9-11, 13-15, 20-22, 24, 40-42, 46-52, 54, 56-64, 104-106, 108, 110, and 111-114 are currently pending in the application. The subject matter of claims 8 and 19 has been incorporated into claims 1 and 13 and original claims 8 and 19 have been cancelled. Claims 1, 9, 13, 20, 47, 48, 52, 54, 104, 105, and 111, have been amended and new claims 112-114 have been presented. No new matter has been introduced by the instant amendments. Applicants reserve the right to pursue the subject matter cancelled from the instant application in one or more continuation applications. The rejection of the instantly claimed subject matter will be addressed upon representment of the claims.

Claims 47 and 48 were rejected under 35 U.S.C. 112, second paragraph, as being allegedly indefinite for failing to particularly point out and distinctly claim the subject matter which applicants regard as the invention.

Claims 47 and 48 have been amended to provide ranges of the number of siloxane repeat units present in the amino-propyl terminated polysiloxane monomers provided in claims 47 and 48.

Example 7 of the instant application as filed provides a method of making a polyimide aerogel comprising a bis(3-aminopropyl) terminated poly(dimethylsiloxane) (amine number 0.6-0.8 meq/g, about  $3 \times 10^{-4}$  mole and 10% in the solid content). The number of siloxane repeat units (x) is between 32 and 44 for bis(3-aminopropyl) terminated poly(dimethylsiloxane) having a milliequivalent amine content of between 0.6 and 0.8 meq/g based on the following calculations:

Molecular weight for bis(3-aminopropyl) terminated poly(dimethylsiloxane) monomer having a 0.6-0.8 meq/g value range from 2500 to 3333 g/mole (Molecular weight =  $3333 \text{ g/mole} = 1 \text{ g}/0.6 \text{ meq} * 1000 \text{ meq/l eq} * 2 \text{ eq/l mole}$ ; Molecular weight =  $2500 \text{ g/mole} = 1 \text{ g}/0.8 \text{ meq} * 1000 \text{ meq/l eq} * 2 \text{ eq/l mole}$ ).

The weight of the each 3-aminopropyl residue is 58 g/mole (two weigh 116 g/mole). Thus, the dimethylsiloxane portion of the bis(3-aminopropyl) terminated poly(dimethylsiloxane) monomer is between 2384-3217 g/mole.

The molecular weight for each dimethylsiloxane repeat unit ( $\text{OSi}(\text{Me})_2$ ) is 74 g/mol. The number of dimethylsiloxane repeat units (x) is then calculated by dividing that portion of the monomer molecular weight attributable to the poly(dimethylsiloxane) residue by the molecular weight of the dimethylsiloxane repeat unit. Thus x is an integer of from 32 to 44 ( $2384/74$  to  $3217/74$ ).

Thus, claims 47 and 48 as amended provide definitions for variable x which are fully supported by the original disclosure.

Claim 42 was objected to under 37 CFR 1.75(c) as being allegedly of improper dependent form for failing to further limit the subject matter of previous claim.

The objection is traversed.

The Office Action has averred that claim 42 depends from cancelled claim 43. This is not true.

Claim 42 is a process claim depending from claims 1 or 13. Thus, claim 42 properly identifies additional process steps for the method of making polyimide aerogels of claim 1 or the

method of making carbon aerogels of claim 13.

Claim 52, which originally depended from claim 43, has been amended to depend from claims 1 and 13. No new matter has been introduced by the instant amendments.

Thus, claims 42 and 52 comply with the multiple dependent claim format required by 37 C.F.R. 1.75(c) and set forth in MPEP §2173.05(n) and the objection should be withdrawn.

Claims 1-3, 8-11, 13-15, 19-22, 24, 40-42, 36-52, 54, 56-64, 104-106, 108, 110, and 111 were rejected under 35 U.S.C. §103(a) as being allegedly unpatentable over Suzuki (U.S. Patent 6,399,669) in view of Barringer (U.S. Patent 5,234,966) taken with Mayer (U.S. Patent 6,332,990).

The rejection is traversed.

As an initial matter, the office action has not set forth a reasonable basis for the combination of the disclosures of Suzuki and Barringer. Suzuki is directed to certain polyimide aerogels, carbon aerogels and methods of making same, which aerogels have a nanoporous structure. In contrast, Barringer teaches polyimide foams having a foam-enhancing protic additive.

As is well known in the art, foams have a macroporous structure which has different physical and mechanical properties compared to aerogels. In addition, foams are prepared by processes which are completely different from those used to make aerogels.

One of ordinary skill in the art would not have been motivated to introduce ingredients used in foam formulations into aerogel formulations. That is, one of ordinary skill in the art would not have been motivated to substitute the polyimide monomers used in Barringer or to

incorporate the additives present in Barringer's foams into the Suzuki aerogels. Moreover, the patent office has failed to establish that one of ordinary skill in the art would have a reasonable expectation of success if such a combination was made.

For at least the above reasons, the combination of Suzuki and Barringer is improper.

However, even if the Suzuki and Barringer references are combined, they still do not teach the methods of making polyimide aerogels of claim 1, the methods of making carbon aerogels of claim 13, the aerogel compositions of claim 54, or the articles of manufacture of claims 104, 106, 108, or 111.

Claim 1

Claim 1, as amended, provides methods of making polyimide aerogels comprising the steps of:

1. preparing a poly(amic acid) resin from a diamine and a dianhydride in a first solvent;
2. contacting the poly(amic acid) resin in the first solvent with a chemical dehydrating agent to form a polyimide gel; and
3. drying the polyimide gel under supercritical conditions to form a polyimide aerogel.

Thus, the claimed method of making polyimide aerogels conducts both the step of forming the poly(amic acid) and contacting the poly(amic acid) resin with the chemical dehydrating agent in said first solvent.

In contrast, Suzuki fails to teach a method of preparing a polyimide aerogel in which the reactions forming the polyimide precursor (e.g., the poly(amic acid)) and the polyimide are

conducted in the same solvent.

More particularly, Suzuki teaches method A of forming a polyimide aerogel in which a polyimide precursor is first prepared and then thermally or chemically imidized. See, column 6, line 51 to column 9, line 60 and particularly column 7, lines 45-67. The recited method of chemical imidization is recited at column 7, lines 62-67. More particularly, Suzuki teaches that “imidization by chemical treatment may be performed by, for example, immersing the polyimide precursor in a dehydrated solvent such as acetic anhydride or pyridine to form an imide ring.” Thus, in Method A, the polyimide precursor resin is first isolated from its polymerization reaction medium by precipitation and then immersed in the dehydrating solution.

In Method B, Suzuki teaches first forming a polyimide precursor, then producing a swollen body of the polyimide precursor in a different solvent, third gelling the swollen polyimide precursor and fourth imidizing the gelled polyimide precursor to form a polyimide gel. As Suzuki is understood, the solvent for the second step of swelling the polyimide precursor is a solvent which swells, but does not dissolve, the resin components, or is a solvent mixture. Thus, the solvents that Suzuki teaches in Step B-2 are NOT the same as the solvent used in the polymerization of the polyimide precursor.

Methods C and D are variants of Method B of Suzuki.

Suzuki neither teaches nor suggests a process of preparing a polyimide aerogel in which a common solvent and reaction mixture is used to form the polyimide precursor resin and to form a polyimide gel by imidization of the polyimide precursor with a chemical dehydrating agent.

Neither Barringer nor Mayer overcome the limitations of Suzuki discussed herein. Thus, for at least the reasons discussed herein, claim 1 is patentable over Suzuki in view of Barringer and Mayer. Claims 2, 3, 9-11 in whole and claims 39-42, and 46-52 (in part) depend from claim

1 and are therefore also patentable over Suzuki in view of Barringer and Mayer.

Claim 13

Claim 13, as amended, provides a method of making carbon aerogels comprising 0.01% and about 15% nitrogen by weight. The process of claim 13 incorporates the process of making polyimide aerogels provided in claim 1 as currently amended. Thus, claim 13 includes the steps of making a polyimide gel in which the gel is prepared by a process in which the poly(amic acid) precursor and the polyimide gel are generated in the same first solvent.

In addition, none of Suzuki, Barringer, or Mayer teach or suggest a carbon aerogel comprising nitrogen or methods of making such a carbon/nitrogen aerogel.

Thus, for at least the same reasons that claim 1 is patentable over the cited art, claim 13 is patentable over Suzuki in view of Barringer and Mayer. Claims 14-15, 20-22, and 24 (in whole) and claims 39-42, and 46-52 (in part) depend from claim 13 and are therefore also patentable over Suzuki in view of Barringer and Mayer.

Claim 54

Claim 54 provides polyimide aerogels consisting essentially of a polyimide resin composed of an aliphatic diamine or a diamino substituted alicyclic hydrocarbon, or a combination thereof.

Suzuki neither teaches nor suggests polyimide aerogels prepared by condensation of an aliphatic diamine or a diamino substituted alicyclic hydrocarbon or the process of preparing such a polyimide.

Suzuki recites a variety of **aromatic** diamines for use in polyimide resin formation without reciting that they may be replaced with an aliphatic diamine. Moreover, Suzuki does not teach that such a substitution would be desirable.

Barringer does not overcome the limitation of Suzuki.

As discussed supra, one of ordinary skill in the art would not have been motivated to combine Suzuki with Barringer, at least because, Suzuki provides nanoporous polyimide materials and Barringer recites unrelated microporous polyimide foams. In the event that they were combined, one of ordinary skill in the art **may** have an expectation of success if an aliphatic diamine was added as in a minor proportion to the total diamine monomer of the polyimide polymer. However, the office action has failed to establish that one of ordinary skill in the art would have a reasonable expectation of success in preparing polyimide resins in which all of the aromatic diamine monomer is replaced with an aliphatic diamine or a diamino substituted alicyclic hydrocarbon.

Thus, for at least the reasons discussed herein claim 54 is patentable over Suzuki in view of Barringer and Mayer. Claims 56-64 and 112-114 depend from claim 54 and are therefore also patentable over Suzuki in view of Barringer and Mayer.

Claim 104-106, 108, 110-111

Claim 104, as currently amended, provides articles of manufacture composed of a polyimide aerogel of claim 54, e.g., a polyimide aerogel consisting essentially of a polyimide composed of an aliphatic diamine, or a carbon aerogel comprising carbon and nitrogen. The articles of manufacture further comprise metal particles dispersed in the pores of the polyimide or carbon aerogel.

As discussed *supra* Suzuki does not teach or suggest polyimide aerogels of claim 54 or carbon aerogels comprising nitrogen.

Mayer does not overcome the limitation of the Suzuki disclosure. More particularly, Mayer does not teach or suggest articles of manufacture comprising a carbon aerogel containing nitrogen.

Thus, claim 104, which provides articles composed of a polyimide aerogel of claim 54 or a carbon/nitrogen aerogel each of which may have metal particles dispersed in the pores of the aerogel, are patentable over any combination of Suzuki, Barringer, and/or Mayer. Claim 105 depends from claim 104 and is therefore also patentable over any combination of Suzuki, Barringer, and/or Mayer.

Claim 106 provides an electrode composed of at least one aerogel selected from carbon aerogels comprising carbon and nitrogen which has metal particles dispersed in the pores of the aerogel. As discussed *supra*, none of the cited art teach or suggest carbon/nitrogen aerogels or the use of same in articles of manufacture (e.g., in electrodes). Thus, claim 106 is patentable over any combination of Suzuki, Barringer, and Mayer.

Claim 108 provides an electrochemical cell comprising one or more electrodes composed of at least one aerogel selected from carbon aerogels comprising carbon and nitrogen which has metal particles dispersed in the pores of the aerogel. As discussed *supra*, none of the cited art teach or suggest carbon/nitrogen aerogels or the use of same in articles of manufacture (e.g., in electrodes). Thus, claim 106 is patentable over any combination of Suzuki, Barringer, and Mayer. Claim 110 depends from claim 108 and is therefore also patentable over any combination of Suzuki, Barringer, and Mayer.



Claim 106 provides a supported metal catalyst comprising a carbon aerogel comprising carbon and nitrogen having metal particles dispersed therein. As discussed *supra*, none of the cited art teach or suggest carbon/nitrogen aerogels or the use of same in articles of manufacture (e.g., in electrodes). Thus, claim 106 is patentable over any combination of Suzuki, Barringer, and Mayer.

For instance, it is well-known that to establish a *prima facie* case of obviousness, three basic criteria must be met: (1) there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings; (2) there must be a reasonable expectation of success; and (3) the prior art reference(s) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). See MPEP § 2143.

There is no suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the cited references to make the claimed invention, nor is there a reasonable expectation of success.

For at least the reasons discussed herein claims 1-3, 9-11, 13-15, 20-22, 24, 40-42, 46-52, 54, 56-64, 104-106, 108, 110, and 111-114 are patentable over the combined teachings of Suzuki, Barringer, and Mayer. Reconsideration and allowance of claims 1-3, 9-11, 13-15, 20-22, 24, 40-42, 46-52, 54, 56-64, 104-106, 108, 110, and 111-114, as amended, is respectfully requested in view of the foregoing amendments and remarks. This case is believed to be in condition for immediate allowance. Applicant respectfully requests early consideration and allowance of the subject application.

If for any reason a fee is required, a fee paid is inadequate or credit is owed for any excess

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fee paid, you are hereby authorized and requested to charge Deposit Account No. **04-1105**.

Should the Examiner wish to discuss any of the amendments and/or remarks made herein, the undersigned agent would appreciate the opportunity to do so.

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Respectfully submitted,



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